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KAI Direction

- Focus on Efficient Shared Memory Parallelism
  - 2, 4, 8, 16 processor systems becoming commomplace
    - many ISV's and users will start parallelism with these systems
  - coexist with MPI/PVM

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KAP/PRO Toolset

- Guide - common directive set for NT and Unix SMP platforms
- GuideView - visual presentation of parallel performance
- Assure - validates the correctness of parallel programs
- Identical Tools on NT and Unix

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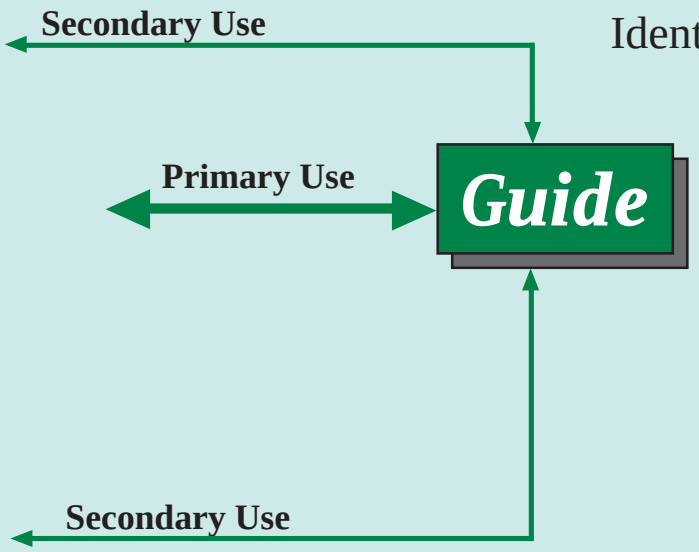
Guide in Parallel Software Engineering

- Steps in Parallelizing an Application
  - **A**nalyze
  - **R**estructure
  - **T**est
  - **I**mprove
  - **Q**/A



Identifying where Parallelism is

User invokes Guide to restructure program

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Guide Design Goals

- Large application considerations
  - Portability
  - Ease of use for end user
- View into parallelism
- Cray/SGI compatibility
- Complement KAP's goals

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Guide Directives

- Control Parallelism
  - Parallel Region
  - Parallel Dos
  - Parallel Sections
- Data Parallelism
  - Shared and Local
  - Parallel Commons
- Synchronization
  - Critical Sections
  - Barriers

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The KAP/PRO Toolset

Guide View **--**

Visualizing Parallelism

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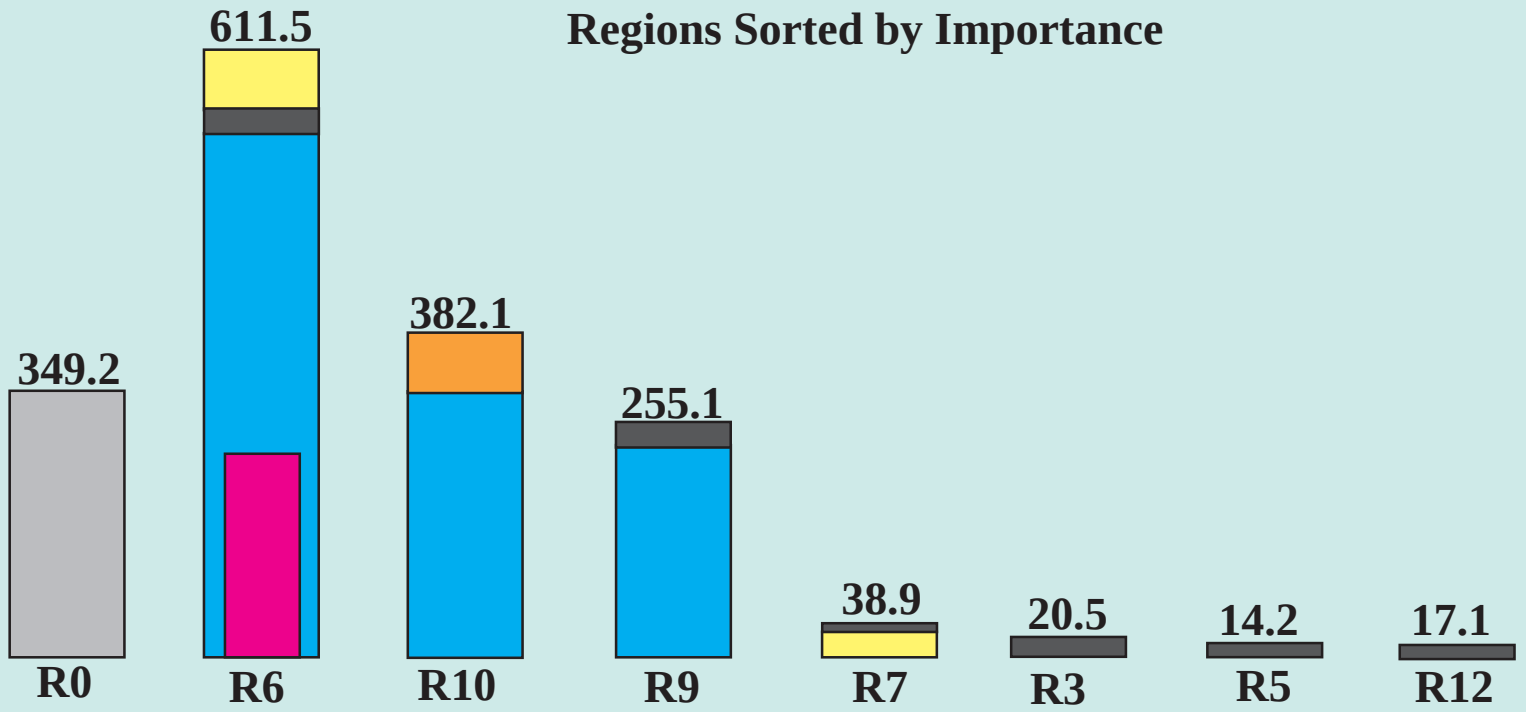
Thread Average Region Times / Importance

0.0 s sequential time
6.1 s synchronized time
16.9 s locks time
1.0 s barriers time
5.9 s imbalance time
225.2 s parallel time

R9 in file dyn0f, routine VCTOR2
at time 12379; invocations 167,164 Overhead 9.09 s



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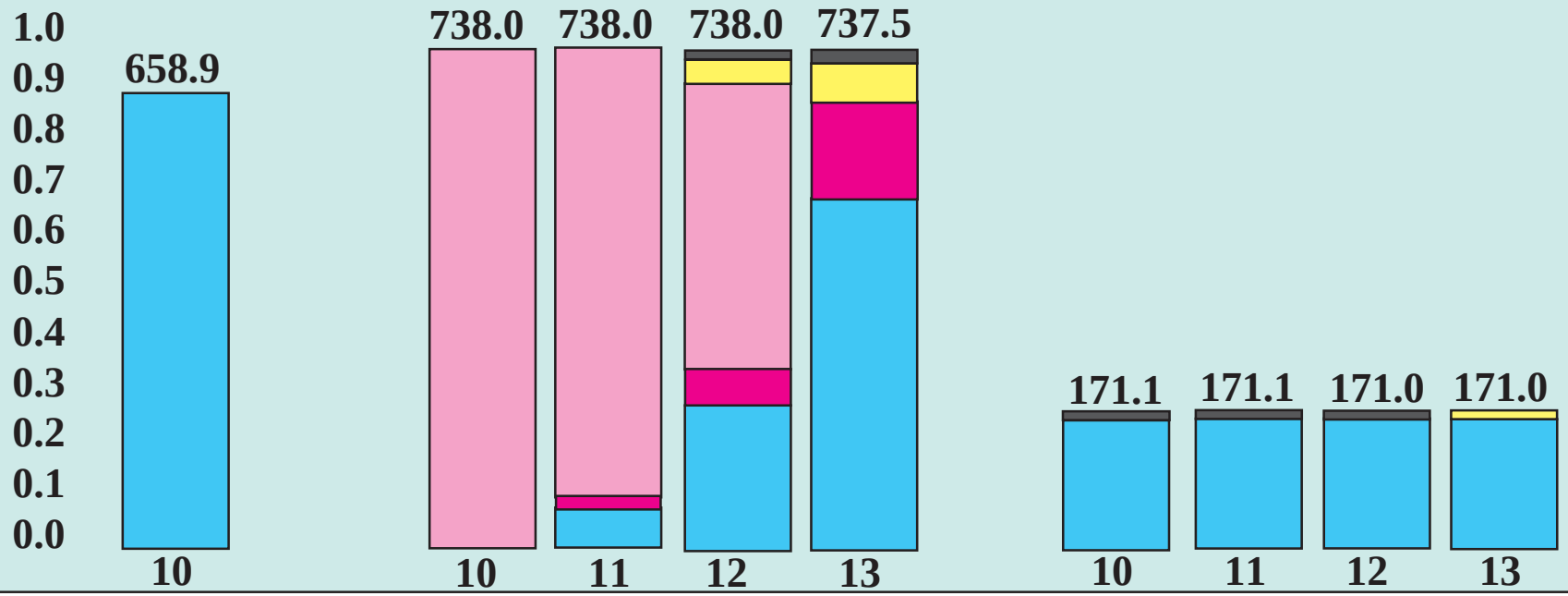
Region - Specific Thread Times-R1

0.3 s	synchronized time	
1.0 s	locks time	
0.0 s	barriers time	
731.3 s	imbalance time	
1.4 s	parallel ovh.	
4.8 s	parallel time	
730.8 s	total time	

TO in file twldrv.f, routine TWLDRV
at time 118, # invocations 1



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Better Tactic For Bugs

- Assure systematically finds Communication Leaks
  - Identifies source of bug as well
  - Finds nondeterministic errors
  - Trades computer time for human time

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Bugs Are Communication Leaks

- Principle --
  - Valid parallel program has
  - Logical communication pattern
- Bugs are -- “Communication Leaks”
  - Either unintended or
  - Intended but missed

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What Is Parallel Validation?

- For any program with KPTS parallelism ***Assure*** will identify incorrect behavior
- What is correct behavior? ***Assure*** uses --
  - the serial program and a provided dataset
- When validated, a program is valid --
  - For any number of processors at runtime
  - For all execution timing variations
  - Against any platform dependencies

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Future Directions

- Pragma/Directive support for parallel C and C++
- Directive support for NUMA/COMA architectures
- Task parallelism support for parallel C++ by Key Words